

## Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process

### Participant

Air Products Liquid Phase Conversion Company, L.P.  
(a limited partnership between Air Products and Chemicals, Inc., the general partner, and Eastman Chemical Company)

### Additional Team Members

Air Products and Chemicals, Inc.—technology supplier and cofunder  
Eastman Chemical Company—host, operator, synthesis gas and services provider  
ARCADIS Geraghty & Miller—fuel methanol tester and cofunder  
Electric Power Research Institute—utility advisor

### Location

Kingsport, Sullivan County, TN (Eastman Chemical Company's Chemicals-from-Coal Complex)

### Technology

Air Products and Chemicals, Inc.'s liquid phase methanol process

### Plant Capacity/Production

80,000 gallons/day of methanol (nominal)

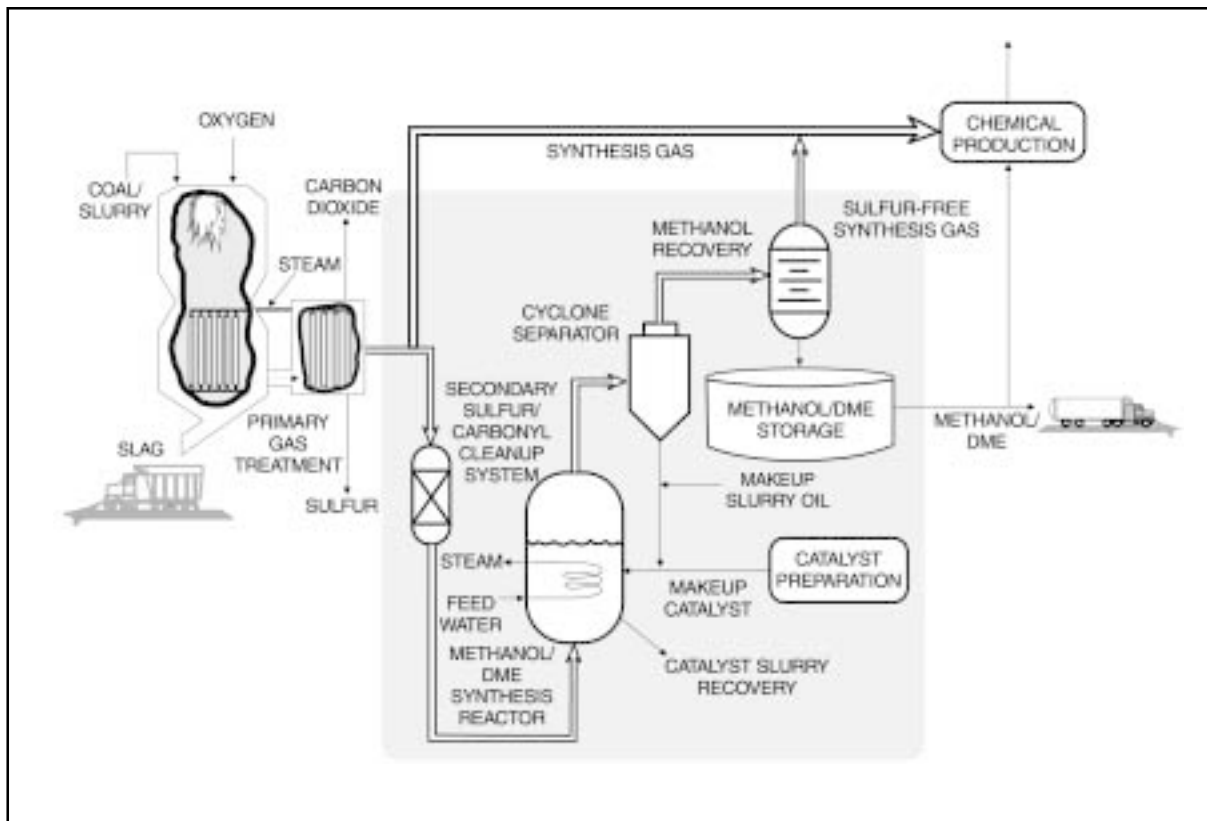
### Coal

Eastern high-sulfur bituminous, 3–5% sulfur

### Project Funding

Total project cost	\$213,700,000	100%
DOE	92,708,370	43
Participant	120,991,630	57

LPMEOH is a trademark of Air Products and Chemicals, Inc.



### Project Objective

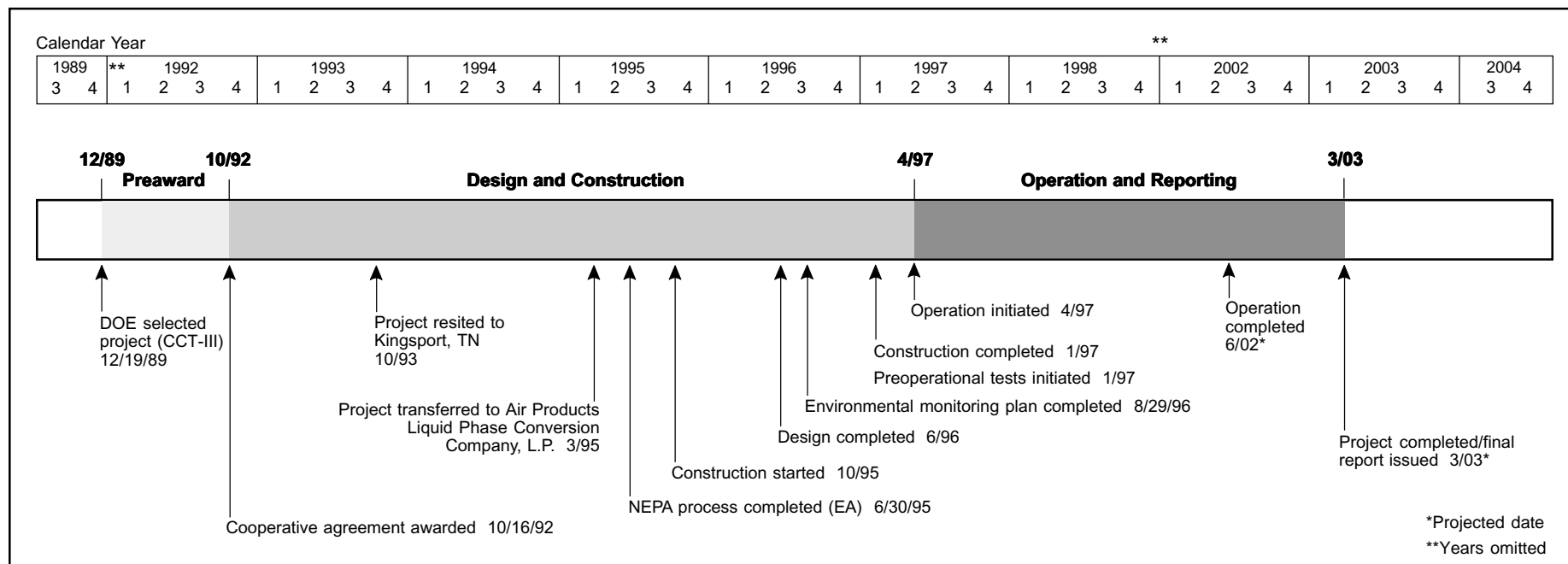
To demonstrate on a commercial scale the production of methanol from coal-derived synthesis gas using the LPMEOH™ process; to determine the suitability of methanol produced during this demonstration for use as a chemical feedstock or as a low-SO<sub>x</sub> emitting, low-NO<sub>x</sub> emitting alternative fuel in stationary and transportation applications; and to demonstrate, if practical, the production of dimethyl ether (DME) as a mixed coproduct with methanol.

### Technology/Project Description

This project is demonstrating, at commercial scale, the LPMEOH™ process to produce methanol from coal-derived synthesis gas. The combined reactor and heat removal system is different from other commercial methanol processes. The liquid phase not only suspends

the catalyst but functions as an efficient means to remove the heat of reaction away from the catalyst surface. This feature permits the direct use of synthesis gas streams as feed to the reactor without the need for water-gas shift conversion.

Methanol fuel testing is being conducted in off-site stationary and mobile applications, such as fuel cells, buses, and distributed electric power generation. Stabilized methanol from the project is being made available to several test locations to study the feasibility of using the product as a feedstock in transportation and power generation applications. Eastern high-sulfur bituminous coal (Mason seam) containing 3% sulfur (5% maximum) and 10% ash is being used.



## Project Status/Accomplishments

The first production of methanol from the 80,000 gal/day unit occurred on April 2, 1997 with the first stable operation at nameplate capacity occurring on April 6, 1997. A stable test period at over 92,000 gal/day revealed no system limitations.

The LPMEOH™ process demonstration unit continues to exceed expectations. Tests have given increased confidence in the use of the LPMEOH™ process for IGCC applications. This confidence level will increase with additional testing of the LPMEOH™ process.

Since startup in April 1997, about 66 million gallons of methanol have been produced and plant availability has exceeded 97.7%. Availability in 1998 through 2000 was in excess of 99.1%. As a result of the successes achieved, the demonstration operations were extended an additional 15 months (through June 30, 2002) to allow for the opportunity to perform new tests that are considered to be of significant commercial interest.

Methods for the removal and control of potential catalyst poisons continue to be an important part of the ongoing plant operation. To support this effort, the catalyst guard bed will incorporate an improved adsorbent material, which is expected to reduce significant poisons such as arsine. The new adsorbent material is a copper oxide impregnated activated carbon that is commercially available. The guard bed and new adsorbent will be placed in service after the implementation of some plant equipment modifications to allow for the adsorbent change.

Engineering for the plant modifications to support *in situ* catalyst activation in the LPMEOH™ reactor has been completed. Currently, catalyst is activated in small batches in a separate vessel and transferred into the LPMEOH™ reactor. *In situ* activation of the methanol catalyst is of commercial significance as it has the potential to simplify equipment and to reduce capital requirements. It is expected that the *in situ* activation demonstration will occur prior to mid-2001.

## Commercial Applications

The LPMEOH™ process has been developed to enhance IGCC power generation by producing a clean-burning, storable-liquid fuel (methanol) from clean coal-derived gas. Methanol also has a broad range of commercial applications; it can be substituted for conventional fuels in stationary and mobile combustion applications and is an excellent fuel for utility peaking units. Methanol contains no sulfur and has exceptionally low NO<sub>x</sub> characteristics when burned.

DME has several commercial uses. In a storable blend with methanol, the mixture can be used as peaking fuel in IGCC electric power generating facilities. Blends of methanol and DME also can be used as a chemical feedstock for the synthesis of chemicals or new oxygenate fuel additives. Pure DME is an environmentally friendly aerosol for personal products.

Typical commercial-scale LPMEOH™ units are expected to range in size from 50,000–300,000 gal/day of methanol produced when associated with commercial IGCC power generation trains of 200–500 MWe.